# ADVANCED COMPUTATIONAL METHODS

**Course Code: 15BM2201**

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**Course Outcomes:** At the end of the Course, Student will be able to

**CO1:** Discuss several important methods with widespread application for solving large system of equations

**CO2:** Appraise the importance of Eigen value problems in engineering sciences.

**CO3:** Analyze experimental data by fitting a polynomial or estimating the derivative or finding the integrals or performing Fourier analysis.

**CO4:** Prepare mathematical model for physical situations and numerically analyze the corresponding ordinary linear/nonlinear, initial/boundary value differential equations.

**CO5:** Prepare mathematical model for physical situations and numerically analyze the corresponding partial linear/nonlinear, initial value/ initial boundary value differential equations.

**UNIT-I** (10-Lectures)

System of linear equations: Gauss elimination method, triangularization method, Cholesky method, Partition method, Error Analysis for Direct Methods.

Iteration Methods: Jacobi Iteration Method, Gauss Seidel Iteration Method, SOR Method.

**UNIT-II** (10-Lectures)

Eigen value and Eigen Vectors, Bounds on Eigen values, Jacobi Method for symmetric matrices, givens method for symmetric matrices, householders method, power method.

**UNIT-III** (10-Lectures)

Numerical differentiation: Introduction, methods based on undetermined coefficients, optimum choice of step length, extrapolation methods,

partial differentiation.
Numerical Integration: Introduction, open type integration rules, methods based on undetermined coefficients: Gauss-Legendre, Gauss-Chebyshev, Romberg Integration.
Double integration: Trapezoidal method.

**UNIT-IV** (10-Lectures)
Numerical Solutions of ordinary differential equations (boundary value problem): introduction, shooting method: linear and non linear second order differential equations.

**UNIT-V** (10-Lectures)
Numerical solutions of partial differential equations: introduction, finite difference approximation to derivatives. Laplace equation- Jacobi method, Gauss Seidel Iteration Method, SOR Method, Parabolic Equations, iterative methods for parabolic equations, hyperbolic equations.

**TEXT BOOKS**:
1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "*Numerical Methods for Scientific and Engineering Computation*", New Age International (P) Limited, Publishers, 4th Edition, 2003.
2. S.S.Sastry, "*Introductory Methods of Numerical Analysis*", Prentice Hall India Pvt., Limited, 4th Edition**.**

**REFERENCE:**
Samuel Daniel Conte, Carl W. De Boor**, "***Elementary Numerical Analysis: An Algorithmic Approach***",** 3th Edition**,** McGraw-Hill.